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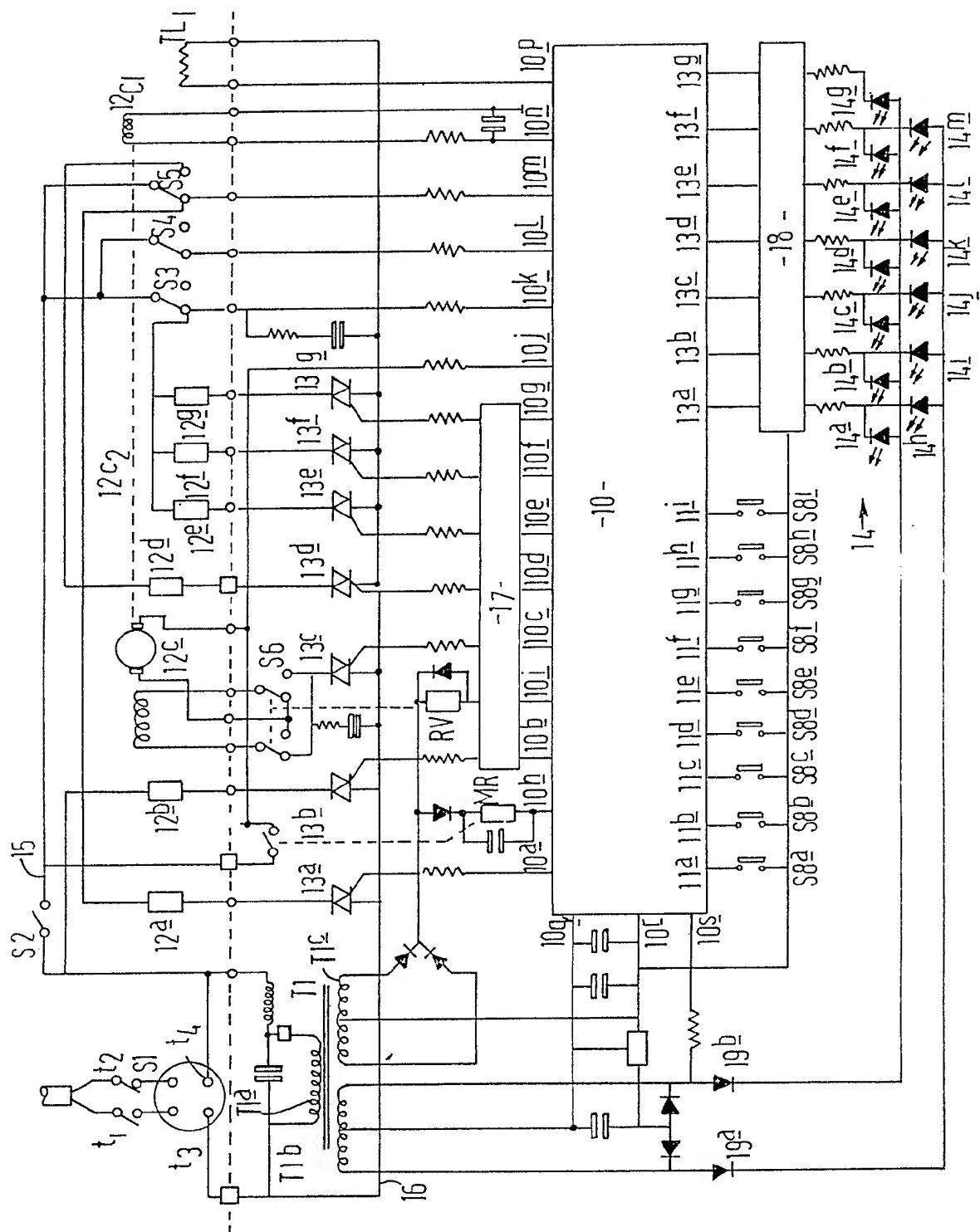
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SPECIFICATION

Improvements Relating to Methods of and Machines for Washing Textile Articles

This invention relates to a method of and machine for washing clothes or other textile articles.

Conventional washing machines comprise a body including a chamber containing a perforated drum mounted for rotation about a horizontal axis and having an opening at one end through which the articles can be loaded into the drum, the latter being driven by an electric motor usually in a cycle which involves rotation in one rotational sense and then rotation in the other rotational sense at a speed in which the articles undergo tumbling action in a washing liquid introduced into the chamber to a level such that the articles in the drum are immersed in the liquid. Such washing action is continued for a relatively prolonged period which is typically 10 to 12 minutes and thereafter the washing liquid (which may contain a detergent) is pumped out of the machine and the articles are subjected to at least one rinsing in fresh water fed into the washing chamber after which it is pumped out, the articles being then subjected to centrifugal extraction by spinning the drum. Usually the rinsing and centrifugal extraction operations are repeated twice more.

Whilst efficient washing of the articles can be achieved by this conventional method, it does consume a considerable amount of energy both by reason of the fact that the washing action is continued for an appreciable period (10 to 12 minutes), and in this action the load of articles is raised from the lowest point of the drum to near its highest point repeatedly, and by reason of the fact that the drum undergoes reversals of rotation so that it has to be repeatedly accelerated from rest to the "tumbling" speed.

The object of the present invention is to provide a method of washing by means of which energy saving can be achieved without detriment to washing performance, that is ability to extract dirt from the articles undergoing washing and thereafter remove it from the vicinity of the articles.

According to the present invention the method of washing textile articles comprises:

- a. substantially immersing the articles in a washing liquid,
- b. subjecting the washing liquid to agitation for a relatively brief period in each of a succession of longer basic periods over such time as is necessary to achieve removal of dirt from the articles into the washing liquid,
- c. removing the articles and washing liquid relatively from the immersed relation.

The term "washing liquid" includes water, water to which a detergent has been added, and water to which a biological agent has been added.

The method preferably includes heating the washing liquid to a relatively low temperature. By "relatively low" is meant a temperature above that at which unheated water available from normal domestic water systems is supplied and which generally is between 4°C and 15°C depending upon climatic conditions, but not higher than is no more than pleasantly warm to the hand. Typically a "relatively low" temperature would be 30°C but it is contemplated that more generally it would be in the range of 20°C to 40°C.

The invention is based on the concept that merely by immersing the articles in the washing liquid, substantially loosening of the dirt with respect to the pores or interstices presented by the articles and in which the dirt has become lodged can be achieved provided the immersion is continued for a sufficient period of time. By agitating the washing liquid the dirt can become dislodged and physically removed from the pores or interstices and is then suspended in the washing liquid. If, however, the agitation is not continued, the dirt tends to form a scum on the surface of the washing liquid and then when the washing liquid is pumped out or the articles are removed from it to bring about a discontinuance of the immersed relation, the scum settles on the surface of the articles and streaks or tide marks are left.

Provided, however, the agitation of the liquid is repeated at the intervals of time aforesaid, the dirt remains distributed throughout the body of washing liquid rather than forming a scum on the surface and the streaking or tide marking effect is eliminated.

There is considerable flexibility of choice as to the ratio of the periods of time over which the agitation of the washing liquid is effected and the basic periods of time. Satisfactory results have been achieved using a ratio of 1 to 20 made up of an agitation period of 30 seconds in a basic period of 10 minutes.

It is contemplated, however, that these periods of time may be varied without deleterious effect based on the following considerations. Lengthening of the periods of agitation results in higher consumption of energy and it is, therefore, undesirable to lengthen these periods unduly if satisfactory loosening and removal of the dirt has already been achieved by the use of shorter periods of agitation. Evidently too big a reduction in the period of agitation will react adversely on washing performance, that is ability to loosen and remove the dirt. It is believed that the ratio above referred to may be increased to 1/5 or reduced to 1/80 without encountering the specific disadvantages referred to any significant extent.

As regards the magnitude of each agitation period, it is considered on the basis of similar considerations that it might be reduced to 15 seconds or increased to 60 seconds and correspondingly the basic period might be reduced to 5 minutes or increased to 20 minutes.

Further, when agitation is effected by rotation at a tumbling speed of a drum rotatable about a horizontal axis and in which both the articles and liquid are present, it is preferred to effect such agitation by increments of rotation of different amounts in opposite directions respectively, e.g. 4 seconds in a forward direction and 2 seconds in a reverse direction.

5 It is not intended that this range of ratios or the ranges of the agitation period and the basic period should be strictly limiting since evidently the degree of contamination of the articles by dirt and the nature of the articles themselves would admit of variations outside these limits being effected without detriment to washing performance or consumption of energy, or indeed with benefit thereto. 5

10 In principle, however, the washing method differs fundamentally from that which is customarily in use, in that it is composed of brief periods of agitation in substantially longer basic intervals repeated over a substantially longer period of time. Thus it is contemplated that the overall period of time may be in the region of 2 hours and preferably will be longer. 10

The steps of the method in accordance with the invention as above defined may be supplemented by the conventional step of supplying water to the articles for rinsing and thereafter 15 subjecting the articles to centrifugal extraction either once or a plurality of times as is conventionally performed. 15

Further, if desired, the steps of the method above defined may be preceded by subjecting the liquid to agitation for a longer time (possibly the whole of the basic period) during the first basic period and thereafter reverting to agitation for said brief period within each subsequent basic period.

20 From a further aspect the invention resides in the provision of a machine for washing textile articles comprising: 20

- a. a body defining a washing chamber for reception of the articles to be washed,
- b. means for supplying washing liquid to said chamber,
- c. means for agitating said liquid in said chamber,
- 25 d. control means for rendering the agitating means operative for a brief period in each of a succession of longer basic periods, 25
- e. means for discharging the washing liquid from said chamber.

Preferably the machine will also include means for heating the washing liquid, and means for controlling the temperature to which it is heated to a relatively low value as herein defined.

30 The ratio of the brief periods of agitation to the basic periods, and the values of each of these periods may be as already referred to in defining the method of the invention. 30

The invention will be described with reference to the accompanying drawings wherein:—

Figure 1 is a diagrammatic view in side elevation and in vertical cross-section of one embodiment of washing machine in accordance with the invention for performing the method thereof;

35 Figure 2 is a schematic circuit diagram of the control circuit of such washing machine; 35

Referring firstly to Figure 1, the washing machine illustrated comprises a body which includes a stationary washing chamber 1 which may be of generally cylindrical form containing a washing drum 2 rotatable about a horizontal axis, the washing chamber being supported in any suitable manner, for example by struts 3 from a base 3a.

40 A casing 4 encloses the washing chamber and drive means for the drum which comprises a motor 12c which drives the drum spindle 2a through the intermediary of a belt and pulley drive 9. The spindle 2a and the drum is supported by a suitable bearing 8 carried by the washing chamber. 40

The washing chamber has a plurality of inlets, for example hot water inlet controlled by a solenoid valve 12e, a cold water inlet controlled by a solenoid valve 12g and a drain outlet preferably 45 communicating with a well or sump in the washing chamber and controlled by an electrically driven pump 12b. 45

The washing chamber 1 is sealed with respect to the casing by a flexible gasket or sealing ring 6 and the entrance to the washing chamber 1 and drum 2 is controlled by a door 5 which is hingedly 50 connected to the casing 4 about a vertical axis 7 and is movable upon release of a solenoid controlled door lock 12a between the closed position shown and an open position. Associated with the door is a sealing ring or gasket 5 operative between the door and the casing. 50

A further functional unit seen in Figure 1 is a heater 12d for heating the liquid in the washing chamber. Other electrically energised functional units are omitted from Figure 1 merely for the sake of simplicity and may include a solenoid operated conditioner valve controlling the flow of conditioning 55 liquid through a duct into the washing chamber. 55

Referring now to Figure 2, the electrically energised functional units are identified at 12a to 12g. The supply of current to these units from a 240 volt alternating current mains is connected to the input terminals t1, t2 of a main manually operable isolator switch S1, the output terminals t3, t4 of which are connected to the primary winding of power supply transformer T1 and also to power supply rails 15 and 16, in the latter case through the intermediary of a switch S2 operated by door release solenoid 60 12a. 60

The supply of current to the functional units 12a to 12g from the conductors 15 and 16 is controlled by respective gate controlled semi-conductor devices 13a to 13g respectively in accordance with the output signals developed at the outlets of control circuits incorporating a micro processor and 65 designated 10a to 10g respectively. In the case of functional units 13b to 13g these outputs are fed 65

through the intermediary of an output driver 17. Associated with the functional devices are a number of supplementary devices which control or contribute to the function performed by the functional devices, these being high, medium and low level switches S3, S4, S5 serving respectively to control current to the hot water solenoid valve 12e, cold water solenoid valve 12f and heater 12d and which provide inputs to the micro processor at terminals 10k, 10l, 10m, to control the liquid levels in the drum. A further supplementary device is a tachometer generator 12c₁ operatively coupled mechanically as indicated by the broken line 12c₂ to drive motor 12c and providing an input to the micro processor at terminal 10n.

A further supplementary device is a thermistor Th₁ which senses the temperature of the washing liquid in the washing chamber and provides an input to the micro processor at terminal 10p.

The direction of energisation of the field winding F of the drive motor 12c is controlled by a further supplementary device, namely a relay RV having reversing contacts S6 and powered from secondary winding T1c, transformer T1 (44 volts). The relay RV is operated under the control of the output at micro processor terminal 10j. The magnitude of the current in the motor is controlled by the output at terminal 10c of the micro processor and current supply to the motor is isolated by a master relay MR having switch contacts S7.

For bringing the washing machine into operation in accordance with the required programme, a series of switches, preferably of the press button type, S8a to S8i provide inputs at terminals 11a to 11i respectively for initiating the following programmes or operations, namely cancel, open door, rinse hold, test, high level, bio, prewash, start, and programme, the significance of which is explained hereinafter.

Indicator means 14 are provided comprising a plurality of electrically energisable indicator elements, for example light emitting diodes 14a—14g which constitute a 7 segment numerical indicator and elements 14h—14m which consist of single light emitting diodes, both sets of light emitting diodes being controlled by outputs at terminals 13a—13g of the micro processor through the intermediary of a display power driver. The two sets of display elements, namely 14a—14g and 14h—14m are each supplied respectively by alternate half cycles of the A.C. electricity supply from transformer secondary T1b via diodes 19a and 19b.

The programming provided by the micro processor is such that certain of the display elements provide different classes of information at stages of operation of the machine. Thus before and during programme selection the single L.E.D.'s 14a—14m indicate options for selection whilst the LED's providing the seven segment numerical indicator will indicate the identification number of the wash programme. After start the single L.E.D.'s 14a—14m indicate progress of the selected wash programme as described later. If a fault develops, the seven segment numerical indicator display is then used to indicate this fact by flashing alternatively 'F' and a code number signifying the nature of the fault.

Referring now to the washing programmes which can be provided under the control of the micro processor, the latter may furnish outputs producing any one of the following.

Home Laundry Consultative Council Programmes Nos. 1 to 9

A typical one of these programmes is as follows.

Programme No. 1 (Very Hot Wash)

1. Fill cold for 10 seconds no action.
Fill hot to mid level with action.
Heat to 85°C with gentle action.
Wash for 12 minutes normal action.
Fill cold to high level with action.
Pump spin at 95 r.p.m. for 1 minute 30 seconds.
2. Fill cold to low level without action.
Continue filling to high level with action.
Rinse for 3 minutes.
Pump spin at 95 r.p.m. for 1 minute 30 seconds.
Pump spin at 850 r.p.m. for 10 seconds.
Pump out with cold valve for 15 seconds.
3. Fill cold to low level without action.
Continue filling to high level with action.
Rinse for 3 minutes.
Pump spin at 95 r.p.m. for 1 minute 30 second.
Pump spin at 850 r.p.m. for 10 seconds.
Pump out with cold valve open for 15 seconds.
4. Fill cold to low level without action.
Comfort valve operated.
Continue filling to high level with action.
Rinse for 3 minutes.

Pause until start is operated, if rinse hold is selected.
 Pump spin at 95 r.p.m. for 1 minute 30 seconds.
 Spin pump for 4 minutes at 850 r.p.m.

- In the above it will be understood that in the sequence referred to in sub-paragraph 1, reference to "fill cold" and "fill hot" includes the addition of a washing powder or detergent as required. The reference to "action" means rotation of the drum firstly in one direction and then in the other. The reference to "pump spin" means operation of the discharge pump accompanied by spinning of the drum. In sub-paragraphs 2 to 4 the reference to "fill cold" means filling with cold water not accompanied by any detergent.
- Programmes 2 to 9 inclusive involve similar sequences of operation to those set forth in sub-paragraphs 1 to 4 above but the variable parameters are as follows.
- The level to which water is added.
 The temperature to which it is heated.
 The length of time in the sequence of paragraph 1 for which action for effecting wash is conducted, and
 The spin speed and duration in the rinse sequences of sub-paragraphs 2 to 4.
- It will be noted that each of the programmes 1 to 9 includes a wash sequence (as defined in sub-paragraph 1 above) in which the action for wash is continued for periods which are typically 5 to 12 minutes and thereafter three rinse sequences follow as typically specified in sub-paragraphs 2 to 4 inclusive.
- A further programme which the machine of the present invention can provide, as one embodiment of and one manner of performing the present invention, is that designated "soak" and the operations in this programme are as follows.
- Programme 0 'Soak' (Gentle Action) All Materials Except Wool or Non Colour Fast**
1. Fill cold for 10 seconds no action.
 Fill hot and cold to high level with action.
 Heat to 30°C with action.
 Wash for 10 minutes.
 SOAK—one tumble action every 10 minutes.
 This sequence will continue until 'START' is pressed.
 Pump spin at 95 r.p.m. for 1 minute 30 seconds.
 2. Fill cold to low level no action.
 Fill cold to high level with action.
 Rinse for 1½ minutes.
 Pump spin at 95 r.p.m. for 1 minute 30 seconds.
 Pump spin at 460 r.p.m. for 10 seconds.
 Pump out with cold valve open for 15 seconds.
 3. Fill cold to low level no action.
 Fill cold to high level with action.
 Rinse for 1½ minutes.
 Pump spin at 95 r.p.m. for 1 minute 30 seconds.
 Pump spin at 460 r.p.m. for 10 seconds.
 Pump out with cold valve open for 15 seconds.
 4. Fill cold to low level no action.
 Fill cold plus fabric conditioner to high level with action.
 Rinse for 1½ minutes.
 Pause until start is operated if rinse hold is selected.
 Pump spin at 95 r.p.m. for 1 minute 30 seconds.
 Pump spin at 460 r.p.m. for 2 minutes.
- It will be noted that although the initial wash sequence set forth in sub-paragraph 1 does include a wash action for 10 minutes, it is thereafter followed by a sequence which involves a tumble action (producing agitation of the liquid) every 10 minutes and typically this agitation may be effected over a relatively brief period of 30 seconds in each of a series of longer basic periods of 10 minutes. This sequence continues until the start control is pressed to bring into operation pump out of the liquid followed by the rinse sequences set forth in sub-paragraphs 2 to 4.
- The sequence of paragraph 1 starting with the first tumble action producing agitation of the washing liquid would be continued for at least 1 hour and preferably longer, for example 2 to 3 hours. It would be possible to set a period automatically for continuance of the tumble sequence of the duration 1, 2 or more hours so that it is not necessary for the operator manually to press the start control and the machine would then continue with the sequences set forth in sub-paragraphs 2, 3 and 4 automatically.
- The principal difference between the 'soak' technique of the present intention and conventional

washes is that *equivalent cleansing* is achieved by long soak at relatively low temperature with minimum agitation compared with a short wash at high temperature with vigorous agitation. The economy is achieved by not heating water to a high temperature, whilst the efficiency of the wash is maintained by the minimum wash action to prevent 'tide-marks' and redistribution of dirt.

- 5 This can be achieved by electronic control of the functional units of the machine without 5
difficulties which would be encountered by use of a mechanical timer due to the long operational
period which may be required e.g. starting the machine at sau 2300 hours and terminating the soak
programme at say 0800 hours the next day. The requisite programme to carry out the soak programme
hereinbefore referred to, followed, if required, by a main washing programme is provided by a
10 microprocessor as more fully disclosed in our co-pending application entitled "Improvements relating 10
to control circuits in or for washing and the like machines or other apparatus" and filed on the same
date as this application.

Claims

- 15 1. A method of washing textile articles comprising: 15
a. substantially immersing the articles in a washing liquid,
b. subjecting the washing liquid to agitation for a relatively brief period in each of a succession of
longer basic periods over such time as is necessary to achieve removal of dirt from the articles
into the washing liquid,
c. removing the articles and washing liquid relatively from the immersed relation. 20
20 2. A method according to Claim 1 including the step of heating the washing liquid to a relatively 20
low temperature.
3. A method according to either of Claims 1 and 2 wherein the ratio of the time period over which
agitation is effected to the basic period between agitations is between 1/5 and 1/80.
25 4. A method according to any one of the preceding claims wherein the duration of each of the 25
agitations is between 15 seconds and 60 seconds.
5. A method according to any one of the preceding claims wherein the duration of each of the
basic periods is between 5 minutes and 20 minutes.
6. A method according to any one of the preceding claims wherein agitation is effected by
rotation at a tumbling speed of a drum rotatable about a horizontal axis and in which both the articles
30 and liquid are present, and the drum is given increments of rotation of different amounts in opposite 30
directions respectively.
7. A method according to any one of the preceding claims wherein the washing is supplemented
by the step of supplying water to the articles for rinsing and thereafter subjecting the articles to
centrifugal extraction either once or a plurality of times.
35 8. A method according to any one of the preceding claims wherein as a preceding operation the 35
liquid and articles are subjected agitation for a longer time (possibly the whole of the basic period)
during the first basic period and thereafter reverting to agitation for said brief period within each
subsequent basic period.
9. A machine for washing textile articles comprising:— 40
40 a. a body defining a washing chamber for reception of the articles to be washed. 40
b. means for supplying washing liquid to said chamber,
c. means for agitating said liquid in said chamber,
d. control means for rendering the agitating means operative for a brief period in each of a
succession of longer basic periods. 45
45 e. means for discharging the washing liquid from said chamber. 45
10. A machine according to Claim 9 including means for heating the washing liquid, and means
for controlling the temperature to which it is heated to a relatively low value as herein defined.
11. A machine according to either of Claims 9 and 10 wherein the control means are operable to
control the ratio of the brief periods of agitation to the basic periods, and the values of each of these
50 periods, as claimed in respect of any one of Claims 3, 4 or 5. 50
12. A machine according to any one of Claims 9 to 11 wherein the means for subjecting the
washing liquid to agitation comprises a drum and means for rotating same about a substantially
horizontal axis in increments of rotation successively in opposite directions and by different amounts.
13. A method of washing textile articles substantially as hereinbefore described.
55 14. A washing machine substantially as hereinbefore described with reference to and as 55
illustrated by the accompanying drawings.